

Thermal evaporation of metals

(please, also print the power point slide showing the evaporator with labeled parts)

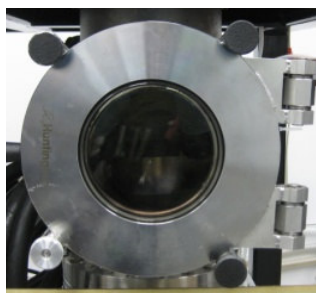
****Nitrile powder-free gloves must be worn while performing all the steps below****

1] Mask your samples and attach them to the rectangular sample holder. For the FET gate deposition, make sure there is a small overlap between the gate area and each of the contacts (source and drain).



2] Open the sample loading port (the upper door). Clean the inner surface of the window and the o-ring using a tissue soaked in isopropanol. Also clean the surface of the matching flange of the chamber. Make sure there is no dirt, debris, lint, fibers or metal particles left on these surfaces. Load the sample holder with the samples facing down (the sample holder must be horizontal) by putting it on the horizontal shaft. Close the upper door.

3] Open the material loading port (the lower door) by releasing 4 knobs while pushing the door toward the chamber. Clean the inner surface of the window and the o-ring using a tissue soaked in isopropanol. Also clean the surface of the matching flange of the chamber. Make sure there is no dirt, debris, lint, fibers or metal particles left on these surfaces.



4] Reach inside and unscrew the two nuts holding down the round cap used to minimize deposition of metal on the chamber walls. Take the cap off the two metal posts and remove it from the chamber.



5] Clean tweezers with acetone. Load about 10 Ag beads into the third boat (boats are numbered from left to right; 3rd boat is marked with a red circle in the photo below). Avoid dropping the beads on the bottom of the chamber – this can shorten the electrical circuitry of the chamber. Use a mirror to check how full is the boat.



6] Inspect the inner surface of the cap. If there is a considerable accumulation of thick silver film, it may cause shorts in the circuitry of the chamber. Remove the deposit by scratching it off with a sharp clean tool, such as tweezers, knife or a screw driver. After this, put the cap back on and fix it with the two nuts (while tightening the nuts it is important to press on the cap down between the posts to prevent cap tilting which may cause a short).

7] Close the lower door by pushing it toward the chamber and tightening the 4 knobs at the same time.

8] Turn on the vacuum gauge (switch is on the back).

9] Check that venting and needle valves are closed, and then turn on the roughing pump. While starting the pump, apply some pressure on the lower door.



10] Wait for the pressure to drop to about 10^{-2} Torr, and then hand tighten the lower door knobs again.

11] Check that the turbo pump controller displays "Ready to START".



12] Press "start" button; the controller will display "start delay" (1 minute) and then will accelerate the turbo pump; wait until speed reaches 27000 rpm. When the pressure reaches sub mTorr range, turn off the vacuum gauge to avoid damaging organic samples with a gauge effect (this is not necessary for devices coated with parylene).

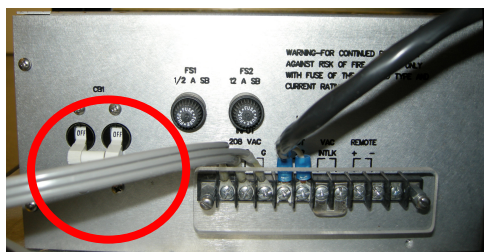
13] When the turbo speed reaches 27,000 rpm, the "green light" turns on indicating a normal operation. Wait for 1.5-2 hours.

14] Turn on the vacuum gauge to check the pressure in the chamber. When it reaches 10^{-6} Torr, proceed to the next step. Depending on the cleanness of the chamber and ambient humidity, it might be necessary to pump for some extra time.

15] Fill the liquid nitrogen trap: pressure will drop by 5-10 times ($1-5 \times 10^{-7}$ Torr). Keep the trap filled with liquid nitrogen during the deposition.

16] Check that the switch for choosing the evaporation boat is on "3" (for Ag evaporation).

17] Turn on the evaporator power supply: the switch is located on the back of the supply (indicated by red circle below).



18] Check that the "output power" light is on, and then slowly rotate the power control dial (small round black knob) clockwise until the indicator reaches zero.



19] Zero out old reading displayed on the thickness monitor by pressing "3". Press "prog" and check the *density*, *z-ratio* and *tooling* settings (they should be: 105, 0.529 and 100 respectively for silver evaporation); modify if necessary, save and press "prog" again to exit the parameter programming.



20] Slowly rotate the dial clockwise while simultaneously checking the color of the boat by looking into the small round mirror attached to the crystal monitor (look through the upper door). When the boat reaches bright orange-yellow color, the Ag beads will melt, which can be observed through the mirror.

21] Tune the deposition speed to $\sim 8 \text{ \AA/s}$ by rotating the dial clockwise a little bit.

22] When the thickness reaches the desired level (usually 20-30 nm for gate deposition), decrease the heater power by fully turning the dial counter-clockwise and turning off the power supply.

23] Wait for two hours for the chamber to cool. During this time, do not fill the cold trap.

24] Press the "stop" button to stop the turbo pump and wait until the speed goes to ~ 0 rpm.

25] Turn off the roughing pump and release the knob on the upper door (inside there is still vacuum).

26] Open the blue plastic valve for venting the chamber with a dry nitrogen; gradually open the needle valve.

27] When the pressure reaches one atmosphere, the upper door will pop up open.

28] Remove the sample holder from the chamber.

29] Close the upper door; close the needle valve and the blue valve; tighten the upper door knob.

****Do not forget the clean up the working area around the evaporator****